

CRUDE PALM OIL CLARIFICATION BY CYCLO-SEPARATOR AND FILTER PRESS SYSTEM

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In the clarification of crude palm oil in the mill, the crude slurry is held for 4 to 7 hr in a vertical clarifier to allow the oil to rise above the sludge. Hot water is added and the temperature maintained at 95°C to reduce the viscosity of the slurry to enhance the rising of the oil. However, these conditions also promote hydrolysis of the oil to free fatty acids and their oxidization to peroxides. These unwanted reactions must be controlled to maintain the oil quality.

A new concept for clarifying crude palm oil was recently proposed by MPOB to reduce the clarification time and hence, the oil quality deterioration. The process uses a cyclo-separator together with a filter press to remove suspended solids from the process stream, thus, reducing the organic constituents of the waste water leaving the

clarification plant. With less solids, less land are required for effluent treatment plant. Thus, leads to a simpler design of the biological process.

PRINCIPLE AND FEATURES

The cyclo-separator is a density separator that converts pressure into rotational momentum to provide the centrifugal force to separate out the solids and oil from the primary liquid. The separation efficiency is determined by the separator's geometrical parameters.

The cyclo-separator has a tangential feed inlet and two outlets - one for the concentrated solids-in-water phase (underflow) and the other for the clean oil. During operation, the crude slurry is fed under pressure to the separator where the

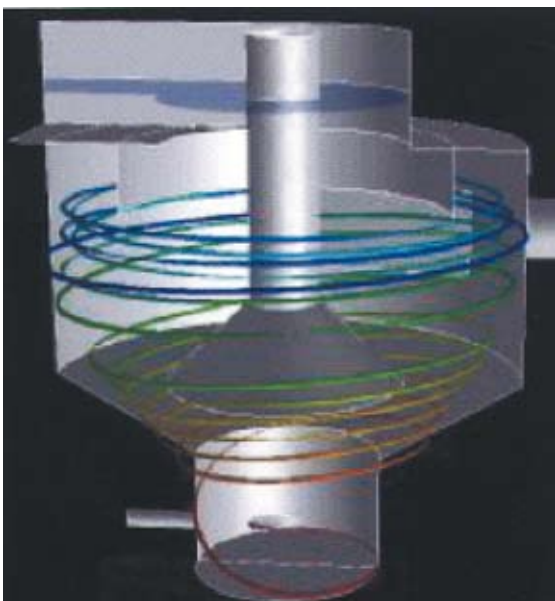


Figure 1. Cyclo-separator.



Figure 2. Oil recovered by cyclo-separator.

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TABLE 1. TYPICAL PILOT TRIAL RESULTS USING A CYCLO-SEPARATOR (50 litres) AND MEMBRANE FILTER PRESS (470 mm x 470 mm)

| | |
|--------------------------|---|
| Type of slurry | Diluted crude oil (45% oil, 6% NOS) |
| Separator retention time | 30 min (max) |
| Oil recovery | ≥ 96% |
| Oil clarity | ≤ 1% dirt |
| Sludge conditioner | High molecular weight cationic polymer |
| Solids content in sludge | 4% (max) for effective mixing |
| Filtration cycle | 90 min |
| Solids recovery | ≥ 95% |
| Solid cake moisture | 50%, subject to polymer conditioning and squeeze pressure |
| Total oil loss | ≤ 4 kg t ⁻¹ FFB |

TABLE 2. ECONOMICS OF THE COMBINED CYCLO-SEPARATOR AND FILTER PRESS SYSTEM FOR CRUDE PALM OIL CLARIFICATION (480 m³ per day) 305 DAYS A YEAR

| | |
|--|--------------|
| Equipment cost | RM 1 000 000 |
| Capital costs per year (depreciation 10 years) | RM 100 000 |
| Operating costs | |
| Filter plate replacement (after 3 years) | 25 000 |
| Filter cloth replacement (after 1 year) | 10 000 |
| Chemicals (flocculent) RM 250 per day | 76 250 |
| Repair & maintenance 2.5% of capital | 25 000 |
| Total O&M costs | RM 136 250 |
| O&M per tonne FFB | RM 0.56 |
| Estimated value of solids* | RM 244 000 |
| Saving from effluent plant maintenance** | RM 80 000 |
| Saving from oil room maintenance ⁺ | RM 156 160 |
| Payback period | 4 years |

Notes: * Expected solids price for composting is RM 40 per tonne at 60% moisture (compost is selling at RM 300 per tonne bulk).

** No pond cleaning is required as the solids are removed before discharge into it.

⁺ Using both the cyclo-separator and membrane filter press together obviates the need for a sludge separator with a saving estimated at RM 0.64 per tonne FFB.



Figure 3. Filter press.

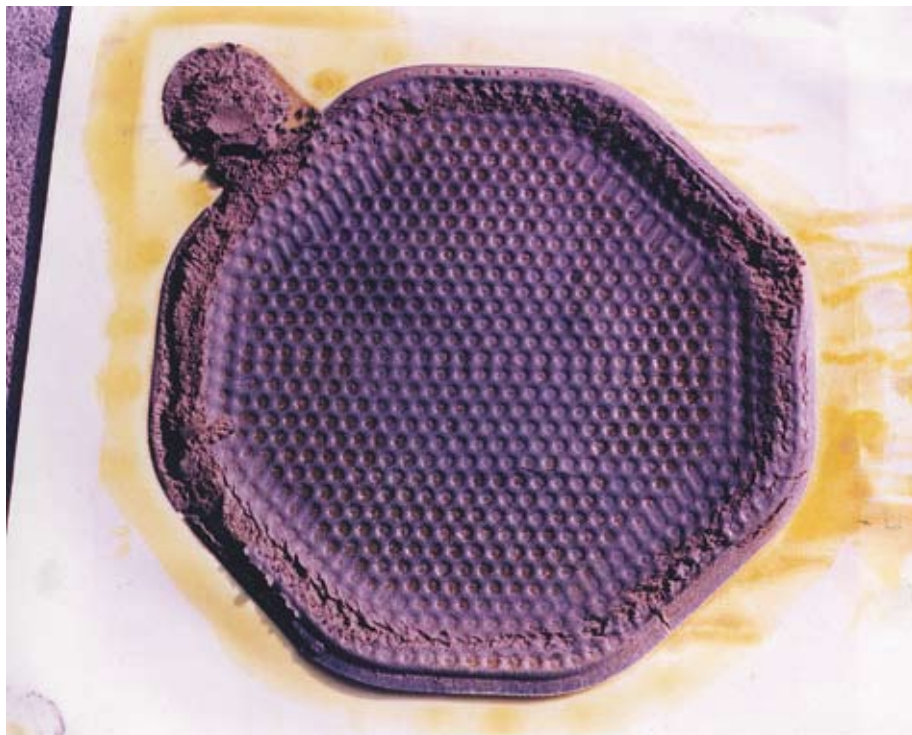


Figure 4. Solid cake.

centrifugal force generated throws the heavier suspended solids towards the wall while the lighter liquid moves to the centre. Two vortices develop. The primary vortex carries the solids to the apex for discharge with the water as sludge, while the secondary vortex carries the clean oil out through the vortex finder pipe.

As the suspended solids in sludge are particles ranging from sub-micron to 100 microns in

size, it is difficult to filter them out in a filter press without first conditioning with a suitable agent. As the particles generally carry a negative or anionic charge, a strong positive or cationic charged coagulant has to be used to neutralize this surface charge. Once the surface charge has been neutralized, the particles will be able to flocculate into larger aggregates. It is sometimes helpful to add a second product to improve the flocculation into larger, denser flocs, which are more easily

removed. A high molecular weight polymer is ideal for this. Once the dense floc has formed, it can be filtered off.

ADVANTAGES

The advantages of the combined cyclo-separator and filter press for crude palm oil clarification are:

- equipment set-up is simple and easy to automate;
- short clarification time;
- high solids recovery by the filter press

after conditioning with the appropriate polymer;

- solids produced are suitable for composting;
- low maintenance cost; and
- good oil quality.

ECONOMICS

The cost to install the cyclo-separator and filter press for crude palm oil clarification is RM 1 000 000 for a 40 t per hr FFB mill. The estimated payback period from the investment is four years.

For more information kindly contact:

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